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A Scheme of Classification of the Varieties of  
Rice found in Burma

BY

R. A. BEALE,

*Assistant Director of Agriculture, Myaungmya.*



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## A Scheme of Classification of the Varieties of Rice found in Burma.

(Received for publication on 11th October, 1926.)

In the course of several year's work on the selection and breeding of rice in Burma, during which a very large number of varieties were handled, the necessity for a simple scheme of classification became apparent.

Both Kikkawa's<sup>1</sup> and Graham's<sup>2</sup> publications on this subject were studied; but the method now adopted and set forth below was worked out more or less independently.

Kikkawa gives two schemes of classification of rice. The first divides rices according to their agricultural characters, and the second by the characters of the grain. He uses only the second method in classifying the Burmese rices. In the present scheme the characters of the grain form the basis of classification. This has been adopted, because in selection one usually starts with the grain, and it is thus possible to divide one's samples into groups according to the size and the shape of the grain. Further, the characters of the grain were found to be more constant than and not subject to environmental influences as, say, the vegetative characters, or, the life period.

The idea in the present scheme is not to study in detail each individual character of each variety, but to form certain definite, standard types, to one of which any variety must belong.

With regard to the utility of the grain we may divide rice into two main classes, namely, non-glutinous and glutinous. Economically the former is the more important, and work has therefore been practically confined to it.

<sup>1</sup> Kikkawa, S. On the Classification of Cultivated Rice. *Jour. Coll. Agri., Imp. Univ. Tokyo*, Vol. III, No. 2.

<sup>2</sup> Graham, R. J. D. Preliminary Note on the Classification of Rice in the Central Provinces. *Mem. Dep't. of Agri. India, Bol. Ser.*, Vol. VI, No. 7, December 1913.

*Grain Shape.* As regards shape of the grain, Kikkawa<sup>1</sup> distinguishes between--

1. Long grain, in which the length is more than twice the breadth, but less than thrice ; or to put it simply :—

$$l > 2b \text{ and } 3 > l/b > 2$$

2. Short grain, where  $l < 2b$  and  $2 > l/b$ .

3. Slender grain, where  $l > 3b$  and  $l/b > 3$

He then subdivides each of the above three into large, medium and small grains.

He says, “ The classification according to the size of the hulled grain too is very useful.....because the rice may be differently used according to its size.....The size of the rice grain may also be expressed by its three dimensions, and (but ?) as the thickness of the rice grain of a certain shape does not show such considerable differences as its other two dimensions, the measurement of the length and breadth can show the relative size with tolerable accuracy. The expression of a relative size of rice grain by the two dimensions is useful for practical purposes, because the measurement is easily done with a simple measure or a micrometer, and it shows at the same time which shape the grain belongs to.

“ The shape of the hulled grain generally coincides with that of the unhulled grain.”

Graham<sup>2</sup> in his “ Preliminary Note on the Classification of the Rices of the Central Provinces ” distinguishes between (a) long and slender (fine) grains, (b) long and broad (coarse), (c) short and narrow, (d) short and broad, and with regard to thickness, flat and bold. Referring to the groups named later, Emata would correspond to (a) above, Byat to (b), Ngasein to (c), and Medon to (d), Letywezin would fall into either (a) or (c), or between them.

The grains of a variety in a pure state vary within very narrow limits in size and shape ; but one frequently finds two varieties the grains of which are at a glance almost indistinguishable from each other. It is in cases like these that a study of the vegetative, floral and other characters is very necessary.

<sup>1</sup> Kikkawa S. On the Classification of Cultivated Rice.

<sup>2</sup> Graham, R. J. D. *Mem. Dept. Agric. India, Bot. Ser.*, Vol. VI, No. 7, December 1913.

The varieties of rice found in Lower Burma may be divided into five main groups according to the size and shape of the grain, as shown below :—

TABLE I.

Group Index	Group name	DIMENSIONS OF GRAINS			
		WITH HUSK		HUSKED	
		Length in mm.	Length Breadth	Length in mm.	Length Breadth
A	Emata . . .	Over 9.40 mm.	Over 3.30	Over 7.00 mm.	Over 3.00
		9.40 to 9.80 mm.	2.80 to 3.30	6.00 to 7.00 mm.	2.40 to 3.00
B	Letywezin . . .	7.75 to 9.00 mm.	2.40 to 2.80	5.00 to 6.40 mm.	2.00 to 2.40
		7.35 to 8.60	2.00 to 2.40	5.00 to 6.00	1.60 to 2.00
C	Ngasein . . .	9.00 upwards	2.25 to 3.00	6.40 to 7.35	2.10 to (awnless) 2.50
		up to 11.25	2.80 to 3.40	7.30 to 8.15	2.60 to (awned) 3.00
D	Medon . . .				
E	Byat . . .				

The group names, Emata, Letywezin, etc., have been adopted, because these are well known Burmese names of typical groups of varieties, the grains of which bear the dimensions stated above.

Now, it will be observed that the length of the grain is not stated definitely as, say, in the case of Emata, 9.40 mm., but as any length from 9.40 mm. upwards. So also, the ratio of length to breadth in the case of, say, Letywezin, may vary in the unhusked grain from 2.80 to 3.30 and in the husked from 2.40 to 3.00. Thus, any variety, the grain of which has dimensions and ratio lying between the limits shown, may be said to belong to this group.

It may also be noticed that the greatest length of Letywezin, *viz.*, 9·80 mm. is more than the least length of Emata, which is 9·40 mm. so also with Letywezin and Ngasein; but it will be found that the ratios between length and breadth in the first four groups do not overlap in any case. Experience shows that this ratio is a better means of distinguishing one group from another, than by length alone, as it gives one an idea of the shape of the grain.

The grains of each of the groups may be described in the following way, and this description will be more easily followed if reference is made to Plate I, Figs. 1 and 2.

A. Emata. Long, slender grain, apiculus very prominent and often curved. Shape of grain linear. Kernel translucent.

B. Letywezin. Slender grain, apiculus prominent, but not curved. Shape lanceolate. Kernel translucent.

C. Ngasein. Short medium grain, apiculus prominent, straight. Shape obliquely obovate. Kernel usually translucent, sometimes with abdominal white.

D. Medon. Short, roundish, bold grain; apiculus-end round without a beak, and usually hairy. Shape broadly elliptic, kernel opaque and chalky.

E. Byat. Large, broad grain; apiculus-end round, beak absent, usually hairy. Shape elliptic. Kernel opaque and chalky.

A note regarding the last group, E. Byat, is necessary. The grains of this group are as long as, or even longer than, those of A. Emata; but they are very much wider, and the shape of the grain is entirely different, being more like that of a large D. Medon, which it resembles in having no beak at the apiculus and in being usually hairy at this end. The beak of A. Emata is on the other hand very prominent and is usually curved. There is thus little likelihood of a Byat grain being confused with one of Emata. Further, the characters of the kernel are very different. Emata has a clear, translucent kernel, while that of Byat is dull, opaque and chalky.

With regard to Ngasein and Medon, although the length of the grains is somewhat similar, it is usually as easy to distinguish one from the other as it is in the case of Emata and Byat, Ngasein being an abbreviated, broad Letywezin and Medon a short, stout Byat. With a little experience one is rarely confused. It sometimes happens, however, that one comes across a variety which may at a glance be, let us say, either a long Letywezin or a short Emata, or perhaps, either a short Letywezin or a long Ngasein.

Careful measurement of the grains, both with and without the husk and calculation of the ratio between length and breadth invariably enables one to determine the group to which it rightly belongs.

Van der Stok<sup>1</sup> says that rice may be divided into three groups according to the nature of the endosperm (1) wholly glassy, (2) milk-white dull grains and (3) more or less glassy, but with a mealy portion of varying size. As regards the second group, he appears from the context to be referring to glutinous rice; but even among non-glutinous varieties alone we can make a similar distinction though it would probably be more correct to describe the second group as dull and chalky.

*Kernel.* Now, as to the kernel Kikkawa says, "In the middle part of the ventral side (on which the embryo is situated) of the non-glutinous rice grain there exists usually a white or chalky-looking portion (abdominal white). The abdominal white is always found in large grains belonging to long-grained and short-grained varieties. I. Inagaki<sup>2</sup> detected that the white-abdomined rice grain is more easily broken by pressure. Moreover he observed that rices not fully matured have mostly abdominal white and sometimes that portion where it exists is slightly depressed. He is also said to have observed that the chalky portion absorbs moisture more rapidly than the normal portion.

With regard to Burmese rice Kikkawa observes that "the abdominal white generally occurs only slightly or is entirely absent in slender grains, while it is often conspicuous in short ones, so that its magnitude seems to some extent to be proportionate to the breadth of the grain."

The abdominal white is not usually found in grains of Enata and Letywezin; but it sometimes occurs among Ngasein, especially when the grains are not properly matured. At the same time, certain races of Ngasein have this characteristic as a hereditary feature, and are on this account not so highly esteemed by the trade as those which have a clear, translucent grain. The reason for the dislike of grains with abdominal white is twofold, one being because the grains having it are more brittle than translucent ones and therefore do not give as high a milling outturn, and the other being because the milled product has not as nice an appearance as the clear pearly grain. In Medon and Byat the grains are almost entirely chalky. Thus Inagaki's statement that the chalky part absorbs moisture more rapidly than the translucent portion may account for the poorer keeping qualities of these rices after milling, if stored in bulk, as compared with Ngasein.

<sup>1</sup> Van der Stok. Notes on the Flowering and Frustration of *Oryza sativa*. 1.

<sup>2</sup> I. Inagaki. Researches on the Rice Plant.

The grouping of varieties, adopted here, has the advantage of classifying them according to their uses in the rice trade. Emata is almost always milled by the parboiling process, and exported chiefly to South Indian ports, where there is a demand for cheap rice. Emata when milled in the ordinary way gives a product of very fine appearance, which is very highly esteemed in Burma and Europe; but owing to its length and slenderness, the breakage is very high. In order to overcome this defect the parboiling process is adopted, the resulting product having a dirty yellow appearance.

Letywezin is milled either by parboiling or in the ordinary way. It suffers to some extent in ordinary milling like Emata, as it is somewhat slender. When parboiled it goes to the same market as Emata. When milled ordinarily it is sometimes graded as an inferior type of Ngasein.

The Ngasein group, which comprises by far the largest number of varieties, and covers the largest area, is the type which gives to Burma her high position in the world's trade in this commodity. Ngasein is both eaten by the poorer classes in the country, and exported to Europe and elsewhere. The bulk of the rice exported from Burma to western countries is Ngasein. It is thus commercially the most important. Owing to its being almost universal in the true rice growing area of Burma, it suffers from a large number of defects. The varieties are very mixed and red grains are very common.

The Medon group comes next in importance to Ngasein, to which it is probably second as regards the area under cultivation. It is exported to the far East, and the better classes in Burma eat this rice almost exclusively, as they prefer it to Ngasein, which is harder and less tasty. The local market price of Medon is always higher than that of Ngasein. Also, on account of its shape, being short and plump, Medon gives a higher milling outturn than Ngasein in spite of the former being chalky. Medon resembles Japanese and Spanish rice in appearance. Its great defect is awning. Awns are more prevalent in Medon than in any other group, while red grain in true Medon is comparatively rare.

The last group, Byat, does not occupy a very important part in the trade, either internal or foreign. It is more or less confined to the southern part of the peninsula, in the Tenasserim Division, and some is also grown in the central part of Burma where irrigation is practised. The trade in this rice is mostly local. While resembling the best Java and Carolina rice in shape and size, it is inferior to them in appearance as a milled product on account of its chalky appearance.

We thus have five main groups arranged according to the characters of the grain. From this we may proceed to the next stage, the floral and vegetative characters.

**Colour.** Violet or purple colour may be present in the stigma, apiculus, leaf-sheath, leaf-blade, ligule and the exposed part of the stem. When this colour is absent these parts are usually green, with the exception of the stigma which is white and the ligule which is whitish-transparent.

To quote Parnell<sup>1</sup>,—"The occurrence of anthocyan pigmentation in some part of the plant is extremely common and different localizations of this colouring form some of the most striking varietal characters."

**Stigma.** The stigma of the rice flower may be either white or dark-purple, (almost black). Van der Stok (*loc. cit.*) speaks of violet or purple and white stigmas, while Graham mentions white, red and black. Red stigmas have not been observed among Burmese varieties except in the case of very immature flowers. The colour of the stigma is a constant character and in crosses it segregates according to the Mendelian ratio, purple being dominant to white. Each of the groups arranged in table I may be sub-divided into those which have purple stigmas and those with white.

**Apiculus.** The apiculus or tip of the fertile glume may or may not be purple. The purple tip, when present is very distinct from the time of full emergence of the ear from the leaf-sheath until the grain is ripe. Occasionally it disappears when the grain ripens, but in other cases it persists as a black or dark brown spot which can be discerned quite easily. The colour of the apiculus is constant and is independent of the colour of the stigma. The absence of purple in the apiculus is, however, very rare when the stigma is purple. We thus get four combinations, each of which forms a sub-division of the main groups in table I.

- (a) Stigma white—apiculus *not* purple.
- (b) " " " purple.
- (c) " purple " *not* purple (very rare).
- (d) " " " purple.

**Leaf-sheath.** Either both the inner and outer surfaces of the leaf-sheath, or only one or other of them may be purple. When this colour is absent the outer surface is normally green and the inner white. The extent of purple colouration, when present, varies considerably. It may range from a faint pinkish tint to deep purple, and it may be present only at the base of the leaf-sheath or over the greater part of the surface. Also, it may appear early in the seedling stage and persist throughout the

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<sup>1</sup>Parnell, F. R., Rangaswami Ayyangar, and Ramiah, K. The Inheritance of Characters in Rice I. *Mem. Dept. Agric. India, Bot. Ser.*, Vol. IX, No. 2, November 1917.

life of the plant, or it may occur for a comparatively short period, frequently when the plant is in full vigour.

Graham (*loc. cit.*) says that all rices which have a purple leaf-sheath have a dark apiculus. The writer has, however, observed in Burma that (1) the leaf-sheath may be purple, while the apiculus is not, and (2) on the other hand, whenever the apiculus is purple, either the inner or outer surface, or both of the leaf-sheath is purple, at some stage of the life of the plant.

As regards the relationship between colour of stigma and that of the leaf-sheath.

(1) When the stigma is white one may get either (a) absence of purple from both the inner and outer surfaces of the leaf-sheath, or (b) presence of purple either on one surface or the other, or on both; and (2) when the stigma is purple, the leaf-sheath is always similarly coloured, either on one or other, or both surfaces.

Hector<sup>1</sup> broadly classifies paddy varieties studied by him at Dacca as follows :—

- “(1) Leaf-sheath, apiculus of the glumes, and stigma coloured.
- (2) Leaf-sheath and apiculus of glumes coloured, but stigma colourless (white).
- (3) Apiculus of glumes and stigma coloured, but leaf-sheaths colourless.
- (4) Apiculus of glumes only coloured.

“It is somewhat doubtful if classes 3 and 4 really exist.”

The writer agrees especially with the last remark. Hector is in agreement with Graham regarding the relation between colour of leaf-sheath and that of apiculus. He goes on to say, “The colour in the stigma, on the other hand, does not always correspond with the leaf-sheath and apiculus colour. It may be colourless, though colour is present in the leaf-sheath and apiculus, or it may be of the same colour as the leaf-sheath and apiculus or it may be of a darker shade.” This also agrees with the present writer's observations.

Parnell in a paper on “Some Mendelian Characters of the Paddy Plant,” read at the Indian Science Congress in January 1915, stated that purple colouration in the tip of fertile glumes, base of the leaf-sheath and stigma was dominant to absence of purple in these parts.

*Leaf-blade.* The lamina is usually green, but the margin, the midrib and sometimes the surface also is purple. The latter colour is usually associated with a similar feature in the outer surface of the vagina.

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<sup>1</sup> Hector, G. P. Observations on the inheritance of Anthocyan Pigment in Paddy Varieties. *Mem. Dep. Agri. India, Bot. Ser.*, Vol. VIII, No. 2, November 1916.

We may now describe the types of which there are seven, into which each of the main groups may be divided.

The first has all recessive colour characters namely, complete absence of purple from all parts of the plant. This is the commonest type found in Burma.

Between this and the opposite extreme type in which all parts of the plant have purple colouration we get five intermediate types.

Stigma white	{ Apiculus not purple	Type 1. Leaf-sheath green outside, white inside. Leaf-blade green, stem green,
		Type 2. Leaf-sheath inside and outside, ligule and margin of leaf-blade all faint purple.
Stigma purple	{ Apiculus not purple	Type 3. Leaf-sheath purple outside, white inside, margin of leaf-blade purple.
		Type 4. Leaf-sheath green outside, purple inside, leaf-blade margin green.
Stigma purple	{ Apiculus purple	Type 5. Leaf-sheath green outside, inside temporarily purple, usually late in development. Other parts <i>not</i> purple.
		Type 6. Leaf-sheath outer surface purple, turning green later. Inner surface purple. Ligule may be purplish. Internodes purple-lined or green. Margin of leaf-blade green.
		Type 7. Leaf-sheath inside and outside purple. Ligular parts usually purplish. Nodes and internodes green or purple-lined. Margin of leaf-blade and midrib purple.

The difference between types 6 and 7 may be a matter of intensity of purple colour in the outer surface of the leaf-sheath and in the lamina; and it may be possible to eliminate type 6 making type 7 cover both. The colour of the stem, of both the nodes and internodes and of the ligule does not appear to be as important as that of the leaf-sheath.

Now each of the five main groups can be subdivided into seven distinct types, all of which are easily recognizable. We thus have 35 types to one of which any variety will belong.

We come to the last means of distinction, *viz.*, agricultural characters. Under agricultural characters we may place habit, life-period, height, tillering, water requirement, yielding capacity.

Three distinct habits have been observed—(1) erect, (2) spreading and (3) prostrate. (Plate III, Fig. 1). The first two are commonest; the last is confined mainly to varieties which normally grow in deep water in flooded areas. When grown under ordinary conditions of cultivation, *i.e.*, in shallow water, the plant sprawls on the ground.

having no water to support it. When this happens roots usually grow at the nodes.

*Life-period.* In the main paddy growing area of Lower Burma, rice is purely a rain-fed crop, sown in June and harvested at the end of the South West monsoon, more or less from the end of November to the beginning of January.

Three kinds of paddy, as regards life-period, are recognized :--

- (1) Early, known in Burmese as "Kaukyin," with a life varying from 90 to 150 days.
- (2) Medium, "Kanklat," from 150 to 170 days and
- (3) Late, or "Kaukkyi" which takes upwards of 170 days to mature.

The life-period of a variety is not constant, but fluctuates within limits. The main factors which affect the duration of the crop are time of sowing, water and soil conditions and season.

The life-periods given above are based on sowing at the beginning of the rains, i.e., early in June. It would probably be more correct to speak of a variety, not as having a life-period of, say, 150 days, but as maturing in a certain month, for the following reason. The emergence of the ear and the ripening of the crop depend not on the period which has elapsed since sowing, but on seasonal changes. This has been proved by sowing seeds of a pure strain at intervals of a week for eight weeks in succession, and planting the seedlings obtained from the different sowings in the same field and under the same conditions of water supply, etc. Plants from the first five sowings (i.e., with an interval of as much as five weeks between the first and the last) produced ears on the same day. The 6th, 7th and 8th sowings shot their ears about three days later, and all matured at the same time.

*Height.* While one meets short, medium and tall varieties, height can hardly be used, except in a few rare cases, as a distinguishing character. The reason for this is because the length of the straw depends largely on the fertility of the soil.

*Tillering.* Without a doubt some varieties tiller more numerously than others; but at the same time, tillering is affected by fertility of the soil and spacing.

*Water-requirements.* Early-maturing varieties require water for a shorter period than late ones, and the choice of a variety depends upon the period during which water lies on the land. Thus, regions of light rainfall i.e., 70-90," require early crops; whereas, where the rainfall

amounts to 100° and more, and where the land is low and holds the water till the end of November or December, late varieties are grown. Even in regions of heavy rainfall early or medium crops are grown where the land is high, and where the water can be drained off readily towards the end of October.

*Yielding capacity.* Some varieties are known to be capable of producing a higher outturn than others; but this is a character that is subject to great variation, depending as it does on the availability of plant food, and general climatic conditions.

Thus none of the agricultural characters, except life-period, afford much help in classification.

A morphological character which has so far been ignored is the conformation of the ear. Ears of different varieties vary considerably in length, in the number of branches of the rachis, and in their arrangement, as well as in the number of spikelets and their setting. (Plate II, Figs. 1 and 2). It is not, however, easy to distinguish between the different types of ear without very minute study, and this is a point which the writer has tried to avoid in this scheme of classification, which is intended to be as simple as possible.

The length, breadth, hairiness, etc., of the leaves has also not been used as a distinguishing character for the same reason.

A detailed key of the arrangement set out above is appended below for reference:—

*Rice. Non-glutinous.*

Group A. Emata. Grain long; slender and linear in shape. dimensions with and without husk respectively being, length over 9.40 mm. and over 7.00 mm.; ratio length : breadth, over 3.30 and over 3.00. Apiculus prominent, often curved. Kernel translucent.

Group B. Letywezim. Grain slender, lanceolate, length with and without husk respectively from 8.40 mm. to 9.80 mm. and from 6.00 to 7.00 mm. length : breadth ratio 2.80 to 3.30 and 2.40 to 3.00. Apiculus prominent, but not curved. Kernel translucent.

Group C. Ngasein. Short, medium grain, obliquely obovate, dimensions, length 7.75 to 9.00 mm. and 5.60 to 6.40 mm. respectively; length : breadth ratio 2.40 to 2.80 and 2.00 to 2.40. Kernel usually translucent, sometimes with abdominal white.

Group D. Medon. Short, roundish bold, broadly-elliptic grain. Length 7.35 to 8.60 mm. and 5.00 to 6.00 mm.; length : breadth ratio 2.00 to 2.40 and 1.60 to 2.00. Apiculus-end rounded, without a beak, and usually hairy. Kernel opaque and chalky.

Group E. Byat. Large, broad grain, elliptic in shape; length over 9.00 mm. and from 6.40 mm. to 7.35 mm.; length: breadth 2.25 to 3.00 and 2.10 to 2.50 when awnless; but length up to 11.25 mm. and from 7.30 to 8.15 mm. and length: breadth from 2.80 to 3.40 and 2.60 to 3.00 when awned. Apiculus-end rounded and usually hairy; no beak. Kernel opaque and chalky.

Each of above groups is sub-divided into the following types:—

- (1) Stigma white, apiculus not purple. Leaf-sheath green outside, white inside, leaf-blade green, stem green.
- (2) Stigma white, apiculus not purple, leaf-sheath inside and outside, (ligule) and margin of leaf-blade faint purple.
- (3) Stigma white, apiculus purple. Leaf-sheath purple outside, white inside; margin of leaf-blade purple.
- (4) Stigma white, apiculus purple, leaf-sheath green outside, purple inside; leaf-blade margin green.
- (5) Stigma purple, apiculus not purple, leaf-sheath green outside. Inside temporarily purple, usually late in development. Other parts not purple. (This type is rare).
- (6) Stigma purple, apiculus purple. Leaf-sheath, outer surface may be purple, turning green later. Inner surface purple. Ligule may be purplish. Internodes purple-lined or green. Margin of leaf-blade green.
- (7) Stigma purple, apiculus purple, leaf-sheath purple on both inner and outer surfaces. Ligular parts usually purplish. Nodes and internodes green or purple-lined. Margin of leaf-blade and midrib purple.

#### **Supplementary Notes.**

The division into 5 main groups according to size and shape of the grain, and the setting of the limits adopted in this scheme for each group may appear to be somewhat arbitrary and the reason for the adoption of these particular limits may be questioned. When the idea of working out a scheme of classification originated, a preliminary survey of several hundreds of varieties of rice, grown in Burma, was made.

In the course of time, as experience was gained, certain definite groups with distinctive characters came to be recognized, and it was found that one could divide the whole collection of varieties into five groups. It was possible to take a sample and say without hesitation—except in a few, rare cases—that it belonged to one or other of these groups.

When these groups had been established, it only remained to define each as has been done. The limits of each group were arrived at by actual measurement of the different varieties which fitted into it.

Neither the colour of the testa of the kernel nor awning is used as a means of distinction. One finds either a red or a white testa. If either is present in one grain it is present in all the grains produced by the plant. In other words, the grains of a plant must all be white, or all red. One does not come across ears of the same plant, some having red and others white grains; nor does one find some grains white and others red in one and the same ear. Redness of the testa is dominant to whiteness, and on crossing, these segregate according to the Mendelian ratio.

The presence of awns is dominant to absence of them, and one gets Mendelian segregation with them. One, however, meets with the presence of awns in a varying degree. For instance, every spikelet may bear an awn, but the lengths of these awns may be more or less uniform or may vary. Then again, some spikelets may have awns and others on the same ear may have none. In fact, it is very difficult to determine in some cases whether a spikelet is awned or awnless, as there may be just the faintest trace or suspicion of an awn, yet it is so small as not to be measurable.

*Winged spikelets.* Occasionally varieties are met with, which have the sterile glumes as long, or almost so, as the fertile glumes but these are not common.

The trade objects to both these winged grains and awns, because when they are present one gets bulk without weight, and the proportion of the actual kernel in a measure of such grain is low. (Plate III, Fig. 2).

*Minute grained varieties.* There are several varieties of rice grown in small quantities which have very small grains. While the actual dimensions of these grains do not correspond with those of the groups, their general shape, and the ratio of length to breadth coincide with those of the main groups; so that one has no difficulty in classifying them. They are not, however, commercially important, and are grown usually for local consumption. (Plate III, Fig. 2).

*Colour of husk and that of testa.* There is no correlation between the colour of these two parts. One may get :—

- (1) Husk straw coloured, testa white.
- (2) " " " " dark.
- (3) " dark " " white.
- (4) " " " " dark.

*Glutinous rices.* The same arrangement of groups as adopted with regard to non-glutinous varieties may be used in connection with glutinous rices. With regard to vegetative and floral characters, the only difference between these two classes of rice lies in the intensity of colouring, when purple is present. One often gets deep purple, almost black, among glutinous rices, whereas in non-glutinous varieties one gets merely pink or red.

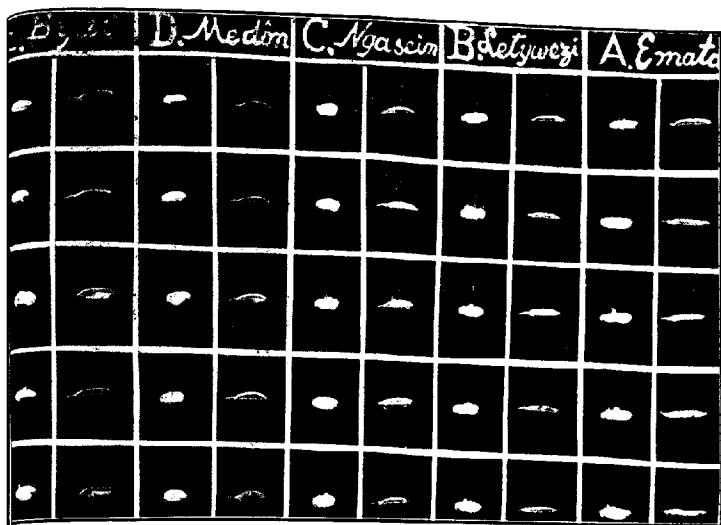


Fig. 1. Paddy and rice grains of typical varieties of each group.

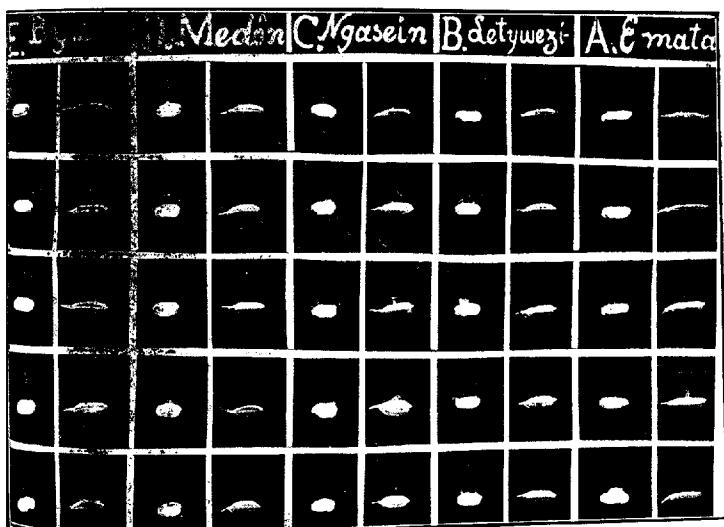


Fig. 2 Paddy and rice grains showing the range of each group.

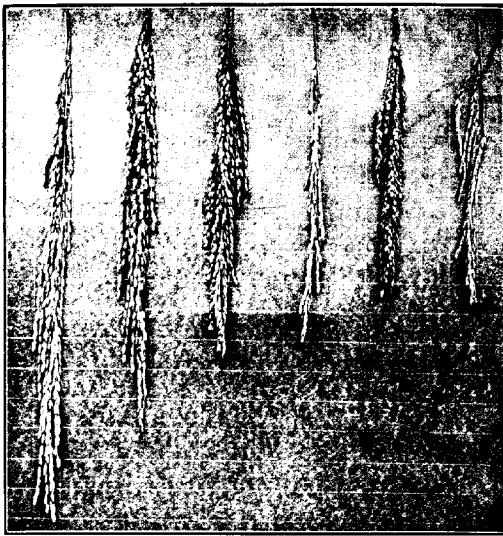


Fig. 1. Showing various types of panicle.

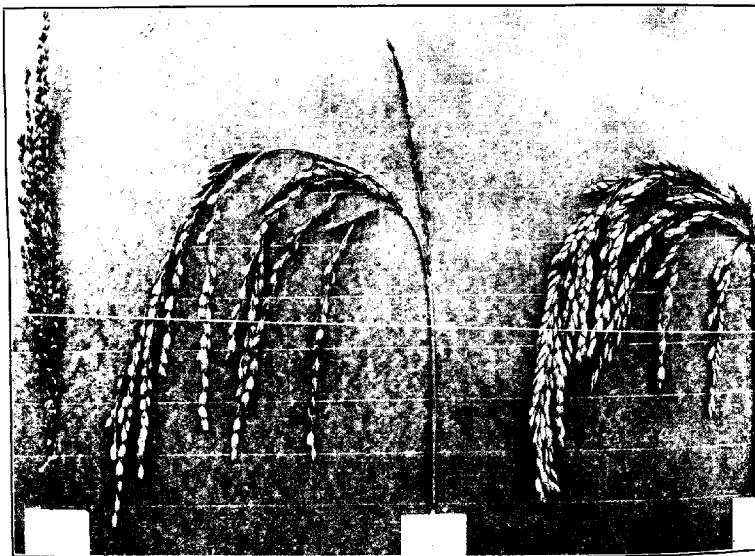


Fig. 2. Showing three distinct types of panicle—(1) Erect, (2) plumose and sparse, and (3) plumose with close overlapping spike

PLATE III.

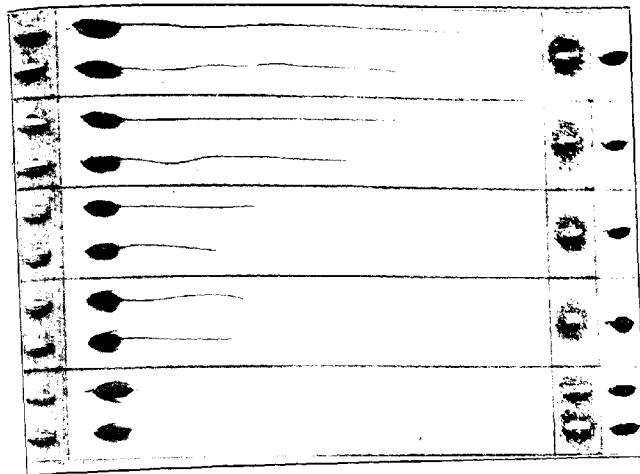


Fig. 2, showing minute traits of awned and winged spikelets.

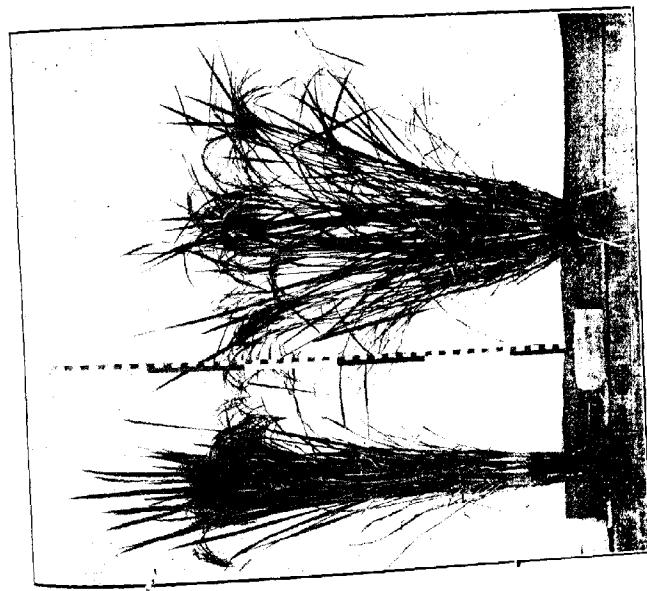


Fig. 1, Showing habit—(1) erect and compact; (2) spreading.

PLATE IV.



Two species of wild rice found in Lower Burma :—

- (1) Awned, long, slender grains ; grows in deep water ; habit prostrate. Purple stigma and apiculus.
- (2) Awnless, round grains ; semi-aquatic. Erect-spreading habit. All parts green.

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